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Who uses Robo-Advisors? The Polish Case

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Abstract:

Purpose: *The article's objective is to present how users evaluate automatic financial advisory services in Poland and their socio-economic characteristics.*
Design/Methodology/Approach: *The financial services sector is undergoing a profound transformation, mainly due to technological factors, the introduction of modern financial solutions, and changes in the main channels of contact and customer service.*
Findings: *The empirical material obtained within the first survey in Poland of robo-advice users indicates that opinions about robo-advice regarding the type of investment strategy used, along with ethicality and prospects of development, tend to be positive, and investors are, on the whole, satisfied with robo-advice.*
Practical Implications: *Knowing the profile of users of automatic financial advice in Poland, robo-advisors can better create and direct their offer to them. The analysis of users' needs and further progress of the implementation work on roboadvice can minimize the risks, such as lack of relationship necessary in the consulting services, full automation of the process of providing services, and satisfying the complex needs of customers.*
Originality/value: *This article deals with the subject of innovation in finance, focusing on robo-advisory services. Since automatic financial advisory services in Poland still enjoy little popularity, we decided to conduct our own research on users of robo-advice in Poland – the first study of its kind.*

Keywords: *Robo-advice, financial advisory, fin-tech.*

JEL classification: *C13, C22, C53, F31, G11.*

Paper Type: *Research study.*

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1. Introduction

Advice is essential for people to achieve their financial goals and dreams. Technology has made it so much easier for consumers to access information, and advisors need to recognize how this impacts their role (Crager and Hummel, 2016). The development of new technologies, innovations, and digitization is becoming a challenge that the financial sector must face. The shift in expectations and needs of customers and investors and the changing environment and market (the impact of, among others, SARS-CoV-2) are influencing a new approach adopted by financial institutions towards investor relations. The use of technological factors in financial services occurs mainly in payments, investments, loans, and insurance. Modern information technologies and the implementation of new solutions and financial tools also support planning personal finances via an automatic advisor that makes decisions on behalf of the client (Waliszewski, 2020).

One might ask oneself about the extent to which the human factor might optimally be substituted by artificial intelligence and computer programs used to manage the investment portfolio. The starting point for the authors' considerations is the identification of robo-advice within fin-tech and analysis of investor profiles in other countries. Based on our conducted research, the article offers an evaluation of automatic financial advice in Poland by its users and analyses the factors determining the use of robo-advisory services in asset management. In the study, the authors aim to present the current profile of robo-advice users in Poland.

2. Robo-Advice in Literature – Essence, Industry Development and Investor Profile

The fin-tech (financial technology) segment comprises inter alia, robo-advice, reg-tech, insure-tech, and digital lending services. Robo-advice technology is based on advanced algorithms using artificial intelligence and tools for analyzing large data sets. The use of robo-advise reduces financial advisory services costs, making them available to a wider group of recipients, especially less affluent individual investors. Robo-advice works via the generation of trading signals regarding financial instruments (Tanda and Schena, 2019). As a computer program, the robo-advisor learns the users' preferences (Thorun and Diels, 2020) and makes financial investments on their behalf, considered optimal at any given moment (Jung, Glaser and Köpplin, 2019). Moreover, robo-advisors (RAs) are widely recognized as one of the most significant and, at the same time, disruptive trends in the asset and wealth management industry (Beketov, Lehmann and Wittke, 2018).

As technology advances, sophisticated robo-advisors are also performing other investment tasks such as portfolio rebalancing, tax-loss harvesting, and also recommending individual stocks (Hodge, Mendoza and Sinha, 2020). The consequence of the fully automated profiling of clients and investments is, among others, a significantly lower fee structure and the possibility to invest small amounts,

as well as the fact that people born between the mid-1990s to early 2000s are robo-advisors' primary target group – they constitute an investor group more enticed by using new technology than investing huge amounts of money (Sironi 2016; Jung *et al*., 2017; Jung *et al*., 2018; Jung *et al*., 2019). The starting point for further considerations is a review of the definition of robo-advice (Table 1).

Table 1. *The essence of robo-advice – selected definitions*

M.I.Fein	The term 'robo-advisor' refers to any of a growing number of Internet-based investment advisory services aimed at retail investors that have emerged in the financial marketplace in recent months. About a dozen or so services of this type with a significant customer base currently exist. More robo-advisors are expected to appear in the future.
ESMA	Means the provision of investment advisory or portfolio management services (in whole or in part) through an automated or semi-automated system serving as a direct customer contact tool
W. Rogowski	A specific group of companies, online platforms (virtual financial consulting) offering independent or network software for managing an investment portfolio with the minimum active participation of a human advisor. They also offer investment advice to unprofessional investors (retail clients).
K. Jajuga	A digital platform that performs automatic algorithmic financial planning services with little or no human input. Most often used to obtain online information about the client's financial situation and goals, and then provide a consulting service or automatically invest funds.
W. Ślązak	The systems of automated financial advice (Financial Robo Advise) are based on the use of algorithms for the construction of investment portfolios and the allocation of assets according to previously identified investor preferences.
R. Milic-Czerniak	The algorithms of automated financial advice as sequences of specific decision-making actions (without human intervention), based on sets of algorithms tailored to the needs and preferences of the investor, are used to allocate assets and construct investment portfolios.

Source: *Waliszewski 2020, p. 14; Rogowski 2017; Ślązak 2018; European Securities and Markets Authority 2016; Milic-Czerniak 2019; Jajuga 2019; Fein 2015*.

The common denominator of the presented definitions is the remote fulfillment of investors' needs and, consequently, a well-matched individual investment strategy. Thus, the virtual advisor adjusts the scope of involvement, depending on the function it performs (Faloon and Scherer, 2017). The USA is considered the cradle of robo-advice. The first entity to offer its clients robo-advice in Poland was Dom Maklerski Efix, which used the Exeria platform (2020) to service it, thereby ensuring clients the opportunity to use ready-made portfolios and algorithms and build their own strategies without any programming experience. At the same time, Slovak Finax offered Polish investors a robo-advisory service. Also, the most important robo-advice players in the world are as follows. In the European Union: ETFmatic, Ginmon, IndeXa Capital, MarierQuantier, Nutmeg, Scalable Capital, Vaamo, WhiteBox, Yomoni. In the USA: TD Ameritrade, Betterment, Bloom,

charlesSCHWAB, FidelityGo, Future Advisor, Personal Capital, Vanguard, Wealthfront, WiseBanyan. In Canada: Nest Wealth, Portfolio IQ, WealthBar. In Switzerland: True Wealth. Additional well-known robo-advisors include Acorns, SigFig oraz Ellevest. Providers such as Wealthfront, Schwab Intelligent Portfolios, and Betterment allow private and/or institutional investors to invest their money in pre-existing portfolios, automatically managed by individually configured algorithms. The advantage of these services lies in the investor's passive role, who may not want or cannot afford ongoing personal monitoring of their portfolio development. Such automated investment services also allow for attractive returns with low starting capital and without specific investment know-how, which stands in contrast to traditional banks' classic investments. In the robo-advisor segment, financial data show assets under the management of automated online portfolios (Statista.com, 2020). According to data by Statista.com (2020), the number of robo-advise users, as well as world market penetration, are increasing, along with a concurrent forecast (as far as 2023) of a decline in growth and stable asset values (Table 2).

Table 2. *Worldwide and Poland – Robo Advisors characteristics*

	2017	***2018***	***2019***	***2020***	***2021***	***2022***	***2023***
	Worldwide						
Assets under Management in million US$	240 025	543 188	980 541	1 442 028	1 863 438	2 231 721	2 552 265
Assets under Management Growth in percent	126,30	80,50	47,10	29,20	19,80	14,40	126,30
Users in thousand	13 104,6	26 100,50	45 773,9	70 508,60	97 397,70	123 538,6	147 018,4
Penetration Rate in percent	0,20	0,40	0,60	0,90	1,30	1,60	1,90
av. Assets under Management per User in US$	18 316,0	20 811,0	21 421,0	20 452,0	19 132,0	18 065,0	17 360,0
	Poland						
av. Assets under Management per User in US$	6 643,0	6 242,0	6 099,0	6 214,0	6 503,0	6 892,0	7 337,0
Users in thousand	3,60	8,80	17,70	29,60	42,80	56,00	67,90

Source: *Statista.com (01.09.2020). Datebase: Statista, last update: 2019-09; exchange rate: 1000 USERS/USD.*

In terms of the Polish market, robo-advice is at a preliminary development stage, taking into account assets under management (AUM), several users, user assets, and market penetration rate. Statistical forecasts evidence this until 2023. The number of active users, according to Statista.com data, will increase from 3.6 thousand people up to 68 thousand. Comparing this on a global scale, the investment value per 1 user is almost 3 times higher. In terms of the value of assets per user, a stable increase will occur from 6.7 thousand USD up to 7.3 thousand USD. The market penetration rate stands at a minimal level, although there is an upwards tendency from 0.01% in 2017 to 0.1% in 2023.

The literature indicates three basic robo-advice systems: informational, supportive, and independent (Ślązak, 2018). The current global trends in robo-advice point to

the use of a hybrid model, where the robo-advisor acquires a range of data and profiles the client, while the final shape of the strategy and recommendations are determined by a traditional advisor (Fisch, Laboré and Turner, 2019). This approach is one of Poland's likely solutions in the coming years, where traditional investment advice still finds support. Enthusiasts of such a solution include users who have investment doubts of an ethical nature and prefer to discuss their decisions and/or reservations with a competent individual (Swenson, 2020). Importantly, how knowledge about remote consultancy is obtained may affect how it is received and, consequently, trust in robo-advisory services. Moreover, human advisors may play a vital role in financial advice when they possess "soft" information about the client (Davies, 2020).

Regardless of the robo-advice service provider and how knowledge is acquired regarding this type of service, it is necessary to reach the widest possible market. Users of virtual financial advisory platforms can be divided into four groups (Samal, Mishra, and Mishra, 2017):

1) *pioneers* – the young generation open to risk, educated, employed in senior positions,
2) *enthusiasts* – older than the pioneers, well-educated, approaching their decisions with caution, not looking for sophisticated investment services,
3) *adopters* – older than enthusiasts, with fewer resources and little experience in investing,
4) *possible adopters* – elderly users who prefer safe investment products.

The leading American market sets the trends and is ahead of the game when assessing and verifying robo-advice user profiles. Eurostat data reveals that the average age of a robo-advice client in the US is approximately 40, while in Canada, it is around 44. The largest percentage of users (5%) is in the population bracket aged 25-54. Among young Europeans aged 16-24, only 2% of users took a loan and arranged credit from a bank or other financial services (Eurostat, 2016). In the USA, people are more likely to use robo-advice than several other technologies that feature in the headlines today, including artificial intelligence and virtual reality (Bektov, Lehmann, and Wittke, 2018). A survey of US residents commissioned by Charles Schwab indicates that 58% of users believe that they will be using some form of virtual consulting by 2025. Also, 67% of respondents believe that the greatest impact of new technologies on financial services will be the elimination of emotions from financial decisions, automatic budget balance (65%), diversified portfolio (60%), more confidence in robots than other investment options (58%) and greater transparency in financial consulting (58%).

Despite the benefits of automation, Americans still feel the need to contact a human advisor when necessary (Millennials 79%; Generation X 73%; Baby Boomers 64%). A problem in the development of robo-advice among investors, according to Gallup's research conducted in the US, is that as many as 55% of investors have not

heard about such a service, and 28% only marginally (FINRA, 2016). To minimize irrational investor behavior using modern technologies, constant financial and technological education is essential (Litterscheidt and Streich, 2020).

3. Methodology

Within the scope of market analysis on robo-advice, Poland's first survey was conducted among individual investors who use automatic financial consulting. The empirical material was obtained online (CAWI) via the Slovak company Finax, which provides pioneering services on the Polish market. Qualitative measurement ensured the collection of 114 questionnaires.

The aim of the study was for investors in Poland to evaluate automatic financial advice. The survey questionnaire contained 23 closed and open-ended questions in the following areas: 1) identification of the robo-advisory solutions used, 2) the type of investment strategy conducted via robo-advice, 3) the amount invested, 4) the number of assets entrusted to be managed by robo-advisors, 5) the level of satisfaction with robo-advice technology, 6) the possible recommendation of such services to friends, 7) how knowledge about robo-advice is acquired, 8) the use of traditional investment consultation, 9) the pros and cons of robo-advice, 10) charges for using robo-advisory services, 11) prospects for the development of robo-advice, 12) the impact of COVID-19 on personal finances, 13) the ethicality of robo-advice, 14) the during of using robo-advisory services.

The survey was conducted with a group of N = 114 people, 87.72% of whom were men, and 12.28% women. The subjects were between 21 and 72 years old, and the mean age was M = 35.60. The largest groups of people were aged 26–30, 31–35, and 36–40. In terms of education, most of the study group consisted of people with higher education (85.09%), while the minority had secondary (13.16%) or vocational education (1.75%) only. Working people accounted for 91.23%, while some individuals were students, retired or unemployed. In terms of residence, people from large cities (48.25%) and medium-sized cities (19.30%) prevailed.

The largest group were people living in a two-person household (36.84%), followed by three-person households (21.93%) and those living alone (20.18%). In terms of average income per person in the household, most people earned between 3001–4000 PLN (31.86%) or over 5000 PLN (30.09%).

Table 3. *Composition of the study group*

		N	*%*			*N*	*%*
Sex	Female	14	12,28%	Place of residence	Village	9	7,89%
	Male	100	87,72%		Town below 50,000 inhabitants	15	13,16%
Age	Below 20	0	0,00%		Town of 50–150,000 inhabitants	13	11,40%
	21-25	12	10,53%		City of 150–500,000 inhabitants	22	19,30%

	26-30	26	22,81%		City above 500,000 inhabitants	55	48,25%
	31-35	27	23,68%	Number of people per household (adults and children)	One	23	20,18%
	36-40	26	22,81%		Two	42	36,84%
	41-45	11	9,65%		Three	25	21,93%
	Over 45	12	10,53%		Four	17	14,91%
Education	Vocational	2	1,75%		Five or more	7	6,14%
	Secondary	15	13,16%	Average income (net) per person per household	Less than 1000 PLN	1	0,88%
	Higher	97	85,09%		1001-2000 PLN	10	8,85%
Work situation	Unemployed	3	2,63%		2001-3000 PLN	21	18,58%
	Student	4	3,51%		3001-4000 PLN	36	31,86%
	Working	104	91,23%		4001-5000 PLN	11	9,73%
	Retired	3	2,63%		5000 PLN or more	34	30,09%

Note: *N- number, %- percentage.*
Source: *Own calculations.*

The following research hypotheses were formulated:

H1: Investors who assessed the prospects of robo-advice in Poland definitely positive evaluated their own satisfaction with this investing higher and would be more willing to recommend this method to their friends.

H2: The level of education, age of investors, and duration of use all impact the number of assets entrusted to robo-advisors. The higher the level of education, the higher the age and the longer the period of use, the higher the number of assets managed by robo-advisors

H3: Investors who apply a balanced strategy evaluated the prospects for robo-advisory development the highest.

H4: Higher evaluation of the ethicality of robo-advisors compared to traditional financial advisors resulted in this service being recommended to friends. People who thought robo-advisors were more ethical than traditional investment advisors were more likely to recommend robo-advice to their friends.

H5: Investors who positively assessed the prospects of robo-advice for the future were more satisfied with this investment method and would be more willing to recommend it to their friends.

4. Empirical Results

According to most respondents (64.86%), robo-advisors are more ethical than traditional financial advisors, while 34.23% of respondents believed that robo-advisors are just as ethical as traditional financial advisors. One person thought that robo-advisors are less ethical than traditional financial advisors.

The respondents usually used robo-advice for a period lasting between 2 weeks and 10 months, and the average period was M = 2.33 months. Most people used robo-advice for between 2–3 months (60.71%).

Table 4. *Evaluation of robo-advice and the duration of using robo-advice*

		N	*%*
Which statement do you think is true?	Robo-advisors are less ethical than traditional financial advisors	1	0,90%
	Robo-advisors are just as ethical as traditional financial advisors	38	34,23%
	Robo-advisors are more ethical than traditional financial advisors	72	64,86%
How long have you used robo-advisory services (in months)?	1 month	31	27,68%
	2-3 months	68	60,71%
	4-6 months	9	8,04%
	Longer	4	3,57%

Notes: *N- number, %- percentage.*
Source: *Own calculations.*

Half of the respondents chose an aggressive type of investment strategy, which they implemented through robo-advice, while 42.11% chose a balanced strategy, and 7.89% opted for a conservative approach. The respondents typically used Finax solutions, ETF investing, passive investing, and wealth-building/savings.

The minimum investment required by the robo-advisors in the study group fell between 0 and 10,000 PLN, and the average was M = 361.63 PLN. Most often, a robo-advisor required a minimum investment of 100 PLN (75.44%).

The current amount of assets entrusted to robo-advice ranged from 100 to 15,000 PLN, and the average was M = PLN 6,975.20. Most people had between 100-500 PLN (28.07%) invested. Satisfaction with robo-advisory solutions was assessed by the respondents on a scale between 2 and 10, and the average rating of satisfaction was M = 7.78 points. The most popular satisfaction rating was 8 points (37.72%).

The respondents also assessed how likely they would be to recommend robo-advice to their friends. These ratings ranged between 3 and 10 points while the average was M = 7.99 points. Most people rated their willingness to recommend robo-advice to a friend at 8 points (35.09%). The respondents usually found out about robotic advisors' services via specialized portals (78.07%) or YouTube channels (10.53%). Apart from robo-advice, 16.67% of the respondents used traditional investment consulting.

In terms of the most significant benefits of robo-advice, the respondents mainly indicated the possibility of making passive investments (85.96%), low consulting costs (73.68%), and a low minimum amount of investment (68.42%). The disadvantages of robo-advice involved the limited range of services (50.88%), and

then the lack of full adjustment to the individual needs of the client (23.68%) as well as low transparency (16.67%).

For management conducted by a robo-advisor, the respondents usually paid a fee of 1–1.23% (71.70% of respondents). The average charge was 0.94%. When signing up for robo-advisory services for the first time, the respondents usually did not pay any charge (76.79%). A 1% fee was paid by 15.18% and a higher amount by 8.04%.

In the opinion of 45.61% of the respondents, the prospects for robo-advisory in Poland are rather positive, while 40.35% regard them as definitely positive. The respondents also assessed that the Covid-19 pandemic, in most cases, had no impact on their personal finances. Income has decreased for some people, while others have increased their savings during this time. Table 5 presents descriptive statistics for amounts invested, fees, and evaluations of robo-advice. For the analyzed variables, the analysis was also performed using the Shapiro-Wilk normality tests, the results of which are also presented in Table 5.

Table 5. *Descriptive statistics and analysis results using Shapiro-Wilk normality tests for amounts invested, fees and evaluations of robo-advice*

	Min	*Max*	*M*	*SD*	*Me*	*Sk*	*K*	*p*
Minimum amount of investment required by the robo-advisor [PLN]	0	10000	361,86	1126,37	100	6,56	50,01	p < 0,001
Current amoung of assets [PLN]	100	150000	6975,20	17804,67	1450	5,84	40,78	p<0,001
Management fee [%]	0	5	0,94	0,60	1	2,43	19,61	p<0,001
Initial fee for robo-advice [%]	0	10	0,42	1,39	0	6,06	40,17	p<0,001
Level of satisfaction with robo-advice [pkt]	2	10	7,78	1,56	8	-0,92	1,13	p<0,001
Willingness to recommend robo-advice to friends [pkt]	3	10	7,99	1,58	8	-0,79	0,84	p<0,001

Notes: *Min- minimum, Max- maximum, M- mean, SD- standard deviation, Me- median, Sk- skewness, K- kurtosis, p- level of statistical significance in the Shapiro-Wilk test.*
Source: *Own calculations.*

All the results of analyses applying Shapiro-Wilk normality tests turned out to be statistically significant at $p < 0.001$. This means that the distribution of variables was statistically significant from the normal distribution. Such conclusions can also be drawn from the high values of skewness and kurtosis for the variables. For this reason, non-parametric tests were used further on in work. Initially, all the analyzed variables were compared according to the type of investment strategy used. The comparison was made by a series of analyses via Kruskal-Wallis tests.

Table 6. *Descriptive statistics for amounts invested, amounts of fees incurred and robo-advice assessments broken down according to investment strategy and results of comparative analyses using Kruskal-Wallis tests.*

	Conservative strategy		Balanced strategy		Aggressive strategy		χ^2	*df*	*p*
	M	*SD*	*M*	*SD*	*M*	*SD*			
Min. amount of investment required by the robo-advisor [PLN]	100,00	0,00	337,5	812,95	423,70	1410,67	0,44	2	0,804
Current amoung of assets [PLN]	4488,9	9600,8	7545,9	22292,4	6887,19	14427,16	0,50	2	0,779
Management fee [%]	0,80	0,50	0,93	0,78	0,96	0,43	4,31	2	0,116
Initial fee for robo-advice [%]	1,22	3,31	0,39	1,51	0,33	0,55	1,62	2	0,444
Level of satisfaction with robo-advice [pkt]	7,33	1,41	7,77	1,60	7,86	1,56	1,10	2	0,578
Willingness to recommend robo-advice to friends [pkt]	8,00	1,41	7,85	1,58	8,11	1,62	0,75	2	0,688

Notes: *M- mean, SD- standard deviation, χ2- Kruskal- Wallis statistic, df- degrees of freedom, p- statistical significance.*
Source: *Own calculations.*

A series of analyses using Kruskal-Wallis tests yielded statistically insignificant results, p> 0.05. This means that the study group's type of investment strategy did not differentiate the investment, fees, or robo-advice ratings. People using a conservative strategy assessed their satisfaction with robo-advice, similarly to those applying a balanced or aggressive strategy. Another analysis examined the relationship between the use of both robo-advice and traditional investment advice with the amount invested, fees, and robo-advice rating. The results of the U Mann-Whitney tests performed for this purpose are presented in Table 7.

Table 7. *Descriptive statistics for amounts invested, fees and robo-advice ratings, broken down between exclusively robo-advice and traditional financial advice as well as the results of comparative analyses using the Mann-Whitney U test.*

	Only robo-advice		Using traditional investment advice		*Z*	*p*
	M	*SD*	*M*	*SD*		
Minimum amount of investment required by the robo-advisor [PLN]	394,22	1225,80	200,05	291,03	0,37	0,713
Current amoung of assets [PLN]	7559,19	19055,02	4055,26	9118,10	1,36	0,173
Management fee [%]	0,95	0,62	0,86	0,46	0,24	0,811
Initial fee for robo-advice [%]	0,47	1,51	0,21	0,42	0,43	0,666
Level of satisfaction with robo-advice [pkt]	7,74	1,53	8,00	1,73	0,93	0,351
Willingness to recommend robo-advice to friends [pkt]	7,96	1,57	8,16	1,68	0,56	0,578

Notes: *M- mean, SD- standard deviation, Z- U Mann-Whitney statistic, p- statistical significance.* ***Source:*** *Own calculations.*

A series of analyses using U Mann-Whitney tests revealed that the use of traditional consultancy beyond robo-advice was not related to the amounts invested, the fees incurred, or the robo-advice rating (statistically insignificant results p> 0.05). People using both traditional and robo-advice assessed their satisfaction with robo-advice, similarly to those using robo-advice exclusively. Furthermore, U Mann-Whitney tests were used to examine the relationship between the ethicality assessment of robo-advisory services, the amounts invested, the fees incurred, and the robo-advice ratings.

Table 8. *Descriptive statistics for amounts invested, amounts of fees charged and robo-advice ratings broken down according to opinion on the ethicality of robo-advice and the results of comparative analyses using U Mann-Whitney tests*

	Robo-advisors are just as ethical as traditional financial advisors		Robo-advisors are more ethical than traditional financial advisors		*Z*	*p*
	M	*SD*	*M*	*SD*		
Minimum amount of investment required by the robo-advisor [PLN]	165,79	249,35	342,39	809,08	1,28	0,200
Current amoung of assets [PLN]	5430,29	8632,02	7800,31	21513,46	0,25	0,801
Management fee [%]	0,86	0,45	0,98	0,66	1,09	0,275
Initial fee for robo-advice [%]	0,25	0,46	0,53	1,71	0,08	0,937
Level of satisfaction with robo-advice [pkt]	7,45	1,84	7,92	1,41	1,21	0,226
Willingness to recommend robo-advice to friends [pkt]	7,34	1,68	8,31	1,43	**3,09**	**0,002**

Notes: *M- mean, SD- standard deviation, Z- U Mann-Whitney statistic, p- statistical significance.*
Source: *Own calculations.*

A series of analyses conducted via U Mann-Whitney tests indicated that the evaluation of the ethicality of robo-advice was not related to the amounts invested or the fees incurred. It was only demonstrated that the assessment of the ethicality of robo-advice proved statistically significant when associated with the probability of recommending robo-advice to friends Z = 3.09; p <0.01. People who thought that robo-advisors are more ethical than traditional investment advisors were more likely to recommend robo-advice to their friends (M = 8.31; SD = 1.43 vs. M = 7.34; SD = 1.68). Subsequent investigations probed whether the analyzed variables were related to the evaluation of robo-advisors' prospects for Poland's future. Comparative analyses were performed using a series of Kruskal-Wallis tests.

A series of analyses using the Kruskal-Wallis tests showed that the assessment of robo-advisors' prospects in Poland was not related to the amounts invested or the fees incurred (statistically insignificant results). It was shown, however, that the prospects of robo-advice in Poland were related to the level of satisfaction with robo-advisory services $\chi 2$ (2) = 17.00; p <0.01 and with the probability of recommending this investment method to friends $\chi 2$ (2) = 11.02; p <0.01.

Table 9. *Descriptive statistics for amounts invested, fees paid and robo-advice ratings broken down according to the assessment of robo-advisors' prospects and the results of comparative analyses using Kruskal-Wallis tests.*

How would you rate the prospects of robo-advice development in Poland:	Quite positive		Positive		Definitely positive		χ^2	*df*	*p*
	M	*SD*	*M*	*SD*	*M*	*SD*			
Minimum amount of investment required by the robo-advisor [PLN]	326,92	1379,63	512,50	997,25	348,96	829,20	2,65	2	0,266
Current amoung of assets [PLN]	5818,67	10133,68	4672,0	7667,34	9083,70	25535,90	2,20	2	0,333
Management fee [%]	0,98	0,73	0,94	0,42	0,88	0,48	0,00	2	0,998
Initial fee for robo-advice [%]	0,31	1,41	0,93	2,55	0,39	0,61	5,25	2	0,072
Level of satisfaction with robo-advice [pkt]	7,40	1,36	7,31	1,58	8,37	1,61	**17,00**	**2**	**0,000**
Willingness to recommend robo-advice to friends [pkt]	7,56	1,43	7,88	1,78	8,52	1,55	**11,02**	**2**	**0,004**

Notes: *M- mean, SD- standard deviation, χ2- Kruskal- Wallis statistic, df- degrees of freedom, p- statistical significance.*
Source: *Own calculations.*

People who assessed the prospects of robo-advice in Poland as definitely positive assessed their satisfaction with this type of investment higher (M = 8.37; SD = 1.61 vs M = 7.40; SD = 1.36 and M = 7.31 ; SD = 1.58) and would be more likely to recommend this method to their friends (M = 8.52; SD = 1.55 vs M = 7.88; SD = 1.78 and M = 7.56; SD = 1.43). Next, the relationship was examined between the level of satisfaction with robo-advice investment and the amounts invested, fees incurred, and the rating of robo-advisors' prospects. These relationships were tested using a series of Spearman's rho correlation analyses, and the results are shown in Table 10 below.

Table 10. *The results of the Spearman's rho correlation analysis for the relationship between the level of satisfaction with robo-advice investment and the amounts invested, the fees incurred and the evaluation of robo-advisors' prospects*

	Level of satisfaction with robo-advice [pkt]	Willingness to recommend robo-advice to friends [pkt]
Minimum amount of investment required by the robo-advisor [PLN]	-0,03	0,05
Current amoung of assets [PLN]	-0,02	0,09
Management fee [%]	-0,09	-0,08
Initial fee for robo-advice [%]	0,08	-0,06
Evaluation of the developmental prospects for robo-advisors in Poland	**0,35*****	**0,31****

Note: ***p < 0,01; ***p < 0,001*
Source: *Own study.*

The results of Spearman's rho correlation analysis showed that the level of satisfaction with robo-advice solutions was not related to the amounts invested and the fees incurred (statistically insignificant results). However, it was shown that the assessment of the developmental prospects for robo-advisors was associated in a statistically significant way with the assessment of satisfaction with robo-advice solutions $\rho = 0.35$; $p < 0.001$ and the willingness to recommend this investment method to friends $\rho = 0.31$; $p < 0.01$. These relationships were positive, which means that people who highly rated the prospects of robo-advice were more satisfied with this investment method and would be more willing to recommend it to their friends. Subsequently, the relationship between the type of robo-advisory strategy implemented and the use of traditional investment consulting, the assessment of the ethicality of robo-advisory, and the prospects of robo-advice was examined. The relationships of these variables were investigated using Pearson's Chi-square tests.

Table 11. *The results of analyses using Pearson's Chi-square tests for the relationship between the type of robo-advisory strategy implemented and the use of traditional investment consulting, the assessment of the ethicality of robo-advice and the assessment robo-advice's future prospects*

		χ^2	*df*	*p*	*V*
Type of investment strategy implemented via robo-advice:	Do you use traditional investment advice apart from robo-advice?	0,23	2	0,891	0,05
	Which statement do you think is true?	4,95	4	0,293	0,15
	How do you rate the developmental prospects of robot-advisors in Poland?	8,29	4	0,082	0,19

Note: *$\chi 2$- Kruskal- Wallis statistic, df- degrees of freedom, p- statistical significance, V- strength of relationship*
Source: *Own study.*

The results of the Pearson's Chi-square test analyses turned out to be statistically insignificant $p > 0.05$, which means that there was no relationship between the type of robo-advisory strategy implemented and the use of traditional investment advice and the assessment of the ethicality of robo-advice. Bordering on statistical significance, it can be noticed that the type of investment strategy was related to the assessment of robo-advisors' prospects $\chi 2\ (4) = 8.29$; $p = 0.082$; $V = 0.19$. The robo-advice prospects were more highly rated by people applying a balanced strategy. Next, the Spearman rho correlation analysis was used again to examine the relationship between age, education, and place of residence with the amount of investment, costs incurred satisfaction with robo-advice and the rating of robo-advice's prospects in Poland.

Table 12. *The results of Spearman's rho correlation analyses for the relationship between age, education and place of residence with the amount of investment, costs incurred, satisfaction with robo-advice and the ratings for its prospects*

	Age	Education	Place of residence
Minimum amount of investment required by the robo-advisor [PLN]	**0,20***	-0,06	-0,06
Current amoung of assets [PLN]	**0,19***	**0,23***	0,00
Management fee [%]	-0,05	-0,11	0,09
Initial fee for robo-advice [%]	-0,08	**-0,26****	-0,14
Level of satisfaction with robo-advice [pkt]	0,01	0,05	0,03
Willingness to recommend robo-advice to friends [pkt]	0,06	0,01	0,06
Evaluation of the developmental prospects for robo-advisors in Poland	0,01	-0,13	0,00

Note: **p < 0,01; **p < 0,01; ***p < 0,001*
Source: *Own study.*

The results of the Spearman's rho correlation analyses revealed that in the study group, age was related to the minimum investment amount $\rho = 0.20$; $p < 0.05$ and the total amount of assets entrusted to robo-advice $\rho = 0.19$; $p < 0.05$. These relationships were positive, which means that older people usually invested larger amounts in robo-advice. It was also shown that the higher the level of education in the study group, the higher the number of assets $\rho = 0.23$; $p < 0.05$, and the lower the assessment of the fee that the respondents paid when starting up with robo-advisory services $\rho = -0.26$; $p < 0.01$. The respondents' place of residence bore no relation to the analyzed variables. Similarly, Spearman's rho correlation analyses were used to investigate the relationship between the number of people in the household, income, and duration of using robo-advice with the amount of investment, costs incurred, evaluation of satisfaction with robo-advice, and the rating of robo-advice prospects for the future in Poland.

Table 13. *The results of the Spearman's rho correlation analysis for the relationship between the number of people in the household, income and duration of using robo-advice with the investment amount, costs incurred, satisfaction with robo-advice and how its prospects are rated*

	Number of people in the household	Average income (net) per person in the household	Duration of using robo-advisory services
Minimum amount of investment required by the robo-advisor [PLN]	0,10	-0,01	0,12
Current amoung of assets [PLN]	0,08	0,15	**0,34****
Management fee [%]	-0,06	-0,13	-0,02
Initial fee for robo-advice [%]	-0,03	-0,18	0,09
Level of satisfaction with robo-advice [pkt]	0,02	0,18	0,11
Willingness to recommend robo-advice to friends [pkt]	0,13	0,08	0,10

Evaluation of the developmental prospects for robo-advisors in Poland	0,02	0,02	0,06

Note: ****p < 0,001*
Source: *Own study.*

Spearman's rho correlation analysis only indicated that the duration of using robo-advisory services was linked in any statistically significant way with the current asset amount $\rho = 0.34$; $p < 0.001$. People who used robo-advice for longer tended to have entrusted more assets to a robo-advisor. No relationship between the analyzed variables with the number of people in the household and income per person was demonstrated. It was also examined whether sex in the studied group was related to the analyzed variables. For this purpose, a series of comparative analyses using the Mann-Whitney U tests were performed.

Table 14. *Descriptive statistics for amounts invested, fees incurred and evaluation of robo-advice, broken down by gender, and the results of comparative analyses using the Mann-Whitney U test*

	Female		Male		*Z*	*p*
	M	*SD*	*M*	*SD*		
Minimum amount of investment required by the robo-advisor [PLN]	385,71	1040,60	358,52	1142,74	0,40	0,689
Current amoung of assets [PLN]	5882,14	10667,34	7128,23	18619,90	0,14	0,887
Management fee [%]	0,90	0,50	0,94	0,61	0,17	0,864
Initial fee for robo-advice [%]	0,31	0,51	0,44	1,47	0,42	0,676
Level of satisfaction with robo-advice [pkt]	7,71	1,94	7,79	1,51	0,06	0,954
Willingness to recommend robo-advice to friends [pkt]	7,86	1,41	8,01	1,61	0,37	0,715

Note: *M- mean, SD- standard deviation, Z- U Mann-Whitney statistic, p- statistical significance*
Source: *Own study.*

Via a series of analyses performed by using the Mann-Whitney U tests, it was demonstrated that gender in the study group was not related to the amounts invested, the fees incurred, or the robo-advice rating (statistically insignificant results $p > 0.05$). Women and men invested similarly in robo-advice services and indicated comparable levels of satisfaction with this investment method.

5. Conclusions and Limitations

The empirical research confirmed research hypotheses (H1)–(H5), because on its basis the following conclusions can be drawn:

1. The evaluation of the ethicality of robo-advice was associated in a statistically significantly way with the probability of recommending robo-advice to friends $Z = 3.09$; $p < 0.01$. People who were of the opinion that robo-advisors were more ethical than traditional investment advisors were more likely to recommend robo-advice to their friends ($M = 8.31$; $SD = 1.43$ vs $M = 7.34$; $SD = 1.68$) .
2. The future prospects for robo-advice in Poland was related to the level of satisfaction expressed with robo-advice solutions $\chi 2\ (2) = 17.00$; $p < 0.01$ and with the likelihood of recommending this investment method to friends $\chi 2\ (2) = 11.02$; $p < 0.01$.
3. People who assessed the prospects of robo-advice in Poland as definitely positive rated their own satisfaction with this type of investing higher ($M = 8.37$; $SD = 1.61$ vs $M = 7.40$; $SD = 1.36$ and $M = 7.31$; $SD = 1.58$) and would be more likely to recommend this method to friends ($M = 8.52$; $SD = 1.55$ vs $M = 7.88$; $SD = 1.78$ and $M = 7.56$; $SD = 1.43$)
4. The assessment of the robo-advice development perspective was linked in a statistically significantly way with the satisfaction rating for robo-advice solutions $\rho = 0.35$; $p < 0.001$ and the willingness to recommend this investment method to friends $\rho = 0.31$; $p < 0.01$. These relationships were positive, which means that people who highly rated the future prospects for robo-advice were more satisfied with this investment method and would be more willing to recommend it to their friends.
5. Verging on statistically significant, it can be noticed that the type of investment strategy was related to how the prospects for robo-advice were rated $\chi 2\ (4) = 8.29$; $p = 0.082$; $V = 0.19$. The robo-advice prospects was best assessed by those applying a balanced strategy.
6. Age was related to the minimum investment amount $\rho = 0.20$; $p < 0.05$ and the total amount of assets entrusted to robo-advice $\rho = 0.19$; $p < 0.05$. These relationships were positive, which means that older people usually invested more in robo-advice.
7. The higher the level of education in the study group, the higher the amount of assets $\rho = 0.23$; $p < 0.05$ and the lower the evaluation of the fee that the respondents paid when starting up with robo-advisory services $\rho = -0.26$; $p < 0.01$.
8. The duration of using robo-advisory services was associated in a statistically significantly way with the current asset amount $\rho = 0.34$; $p < 0.001$. People who used robo-advice for longer more often had a higher amount of assets entrusted to a robo-advisor. No relationship of the analysed variables with the number of people in the household and income per person in the household was demonstrated.

Additionally, on the basis of the obtained empirical material, no statistical relationship was diagnosed in the following variables:

1. The type of investment strategy in the study group did not differentiate the level of amounts invested, fees and robo-advice ratings. People employing a conservative strategy similarly assessed their satisfaction with robo-advice as those who opted for a balanced and aggressive strategy.
2. The use of traditional advice, besides robo-advice, was not related to the amounts invested, the fees incurred and the robo-advice evaluation (statistically insignificant results $p > 0.05$). People using both traditional and robo-advice assessed their satisfaction with robo-advice similarly as those opting for robo-advice exclusively.
3. The assessment of the ethicality of robo-advisory services was not related to the amounts invested or the fees incurred.
4. The assessment of the future prospects for robo-advice in Poland was not related to the amounts invested or the fees incurred
5. Satisfaction with robo-advice solutions was not related to the amounts invested or the fees incurred.
6. There was no relationship between the type of robo-advisory strategy implemented and the use of traditional investment advice and the evaluation of the ethicality of robo-advice.
7. The respondents' place of residence was not related to the analysed variables.
8. Gender in the study group was not associated with the amounts invested, the fees incurred or the robo-advice ratings. Women and men invested similarly in robo-advice services and indicated comparable levels of satisfaction with this investment method.

The authors are aware of the limitations of the conducted empirical study, but its cognitive value in robo-advice user profiling cannot be overestimated and may inspire further in-depth research.

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